Shoshone Hydroelectric Plant Complex
60111 U.S. Highway 6
Glenwood Canyon (Glenwood Springs Vic.)
Garfield County
Colorado

HAER No. CO-5

PHOTOGRAPHS

HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Rocky Mountain Regional Office
Department of the Interior
P.O. Box 25287
Denver, CO. 80225

HISTORIC AMERICAN ENGINEERING RECORD

THE SHOSHONE HYDROELECTRIC PLANT COMPLEX

Location: 60111 U.S. Highway 6, Glenwood Canyon, Garfield County, Colorado

UTM Coordinates:

Hydro Plant: 13/308780 4382210
Intake Dam: 13/311640 4384060
Diversion Tunnel:
A. 13/308760 4382280
B. 13/308850 4382650
C. 13/309110 4382980
D. 13/309490 4383070
E. 13/310020 4383010
F. 13/310680 4383380
G. 13/311220 4383840
H. 13/311320 4384000
I. 13/311600 4384130
J. 13/311640 4384110

Quad: Shoshone, Colorado

Dates of Construction: Hydro plant (1908-09); diversion dam (1907-10); diversion tunnel (1907-09); dates for support buildings and structures vary from 1907 to 1978.

Present Owner: Public Service Company of Colorado
550 15th Street
Denver, Colorado 80202

Present Use: Generation of hydroelectric power.

Significance: The Shoshone complex is significant for being one of the earliest hydroelectric plants on the Colorado River and one of the largest in the Rocky Mountain Region to depend upon the flow of a river for its source of power rather than on the stored water of a reservoir. It is also significant as a remarkable engineering accomplishment in terms of the physical difficulties of construction within Glenwood Canyon and the scale of the undertaking.

Historian: Kenneth M. Gambrill
Colorado Department of Highways
January, 1983

Introduction

Construction of the Shoshone Hydroelectric Plant complex in Glenwood Canyon, Colorado, was an engineering accomplishment of great proportions in the first decade of the twentieth century. Begun near the end of 1906 and completed by the spring of 1911, the complex consists of the power plant and its support buildings, a 2 1/3-mile long water diversion tunnel, an intake diversion dam, and a 153-mile power transmission line. The hydro plant, tunnel, and dam were determined eligible to the National Register of Historic Places under Criteria "A" and "C" in March, 1980. The transmission line has been found to be ineligible for inclusion on the Register.

Projected growth and development along Colorado's western slope and a federal mandate to complete the network of Interstate highways have led to the planned construction of Interstate 70 through Glenwood Canyon. The accepted design calls for replacing the existing two-lane U.S. Highway 6 with a modern four-lane divided Interstate roadway carefully adapted to a combination of engineering, environmental and aesthetic considerations. The Federal Highway Administration is the lead agency in charge of the proposed undertaking, Project I 70-2(70), Glenwood Canyon. The Colorado Department of Highways is the state agency directly responsible for preparing the environmental and engineering studies for the project.

The Shoshone Hydroelectric Plant complex has provided power for the citizens of Colorado through more than 70 years of uninterrupted service. Originally, most of the power generated at Shoshone was transmitted over the mountains to Leadville and to Denver on a 90,000 volt transmission line. This line is still in service today with a 115,000 volt capacity but most of the power from Shoshone is now utilized on Colorado's western slope. A second transmission line of 69,000 volts serves the Glenwood Springs area and ties into a broad western slope transmission network. In addition, the Shoshone plant has a 13,000 volt distribution line which serves the dam site, the White River National Forest rest area east of the dam, and the Denver and Rio Grande Railroad in Glenwood Canyon. This distribution line also provided power to the few residential and commercial

buildings located within the canyon. These buildings have now been removed as part of the Interstate highway construction project.

The Shoshone complex is significant for a number of reasons. First, it is one of the earliest hydroelectric plants of any consequence built along the Colorado River. More significantly, construction of the complex in the depths of Glenwood Canyon was a remarkable engineering accomplishment in terms of the physical difficulties encountered and the scale of the undertaking. Finally, the Shoshone Plant is one of the largest plants in the Rocky Mountain region which depends upon the flow of a river for its source of power rather than on the stored water of a reservoir.

In accordance with Section 800.3 of the Advisory Council on Historic Preservation Regulations, the effects of the Glenwood Canyon project on the Shoshone Hydroelectric Plant complex were evaluated. It has been determined that construction of Interstate 70 through Glenwood Canyon will alter the surrounding environment and the setting of this historic resource and, therefore, will have an adverse visual effect. To mitigate this effect, recordation to National Architectural and Engineering Record standards was prescribed.

Historical Background

In June, 1903, the Colorado Power and Irrigation Company was organized "to furnish electrical power to the various towns in the western part of the state..." A new hydroelectric plant was to be constructed at Shoshone Falls in the canyon of the Grand River (later called Glenwood Canyon).[1] Glenwood Springs, located eight miles west of Shoshone Falls, had built its own small hydro plant in the summer of 1886, but the canyon project was on an entirely different scale and would provide power for a much larger market.[2]

Colorado Power and Irrigation never got its Shoshone Falls project off the drawing board, but the idea and location passed on to the Central Colorado Power Company which incorporated in November, 1906.[3] Central Colorado

Power began construction before the end of 1906 and completed most of the work in 2½ years.

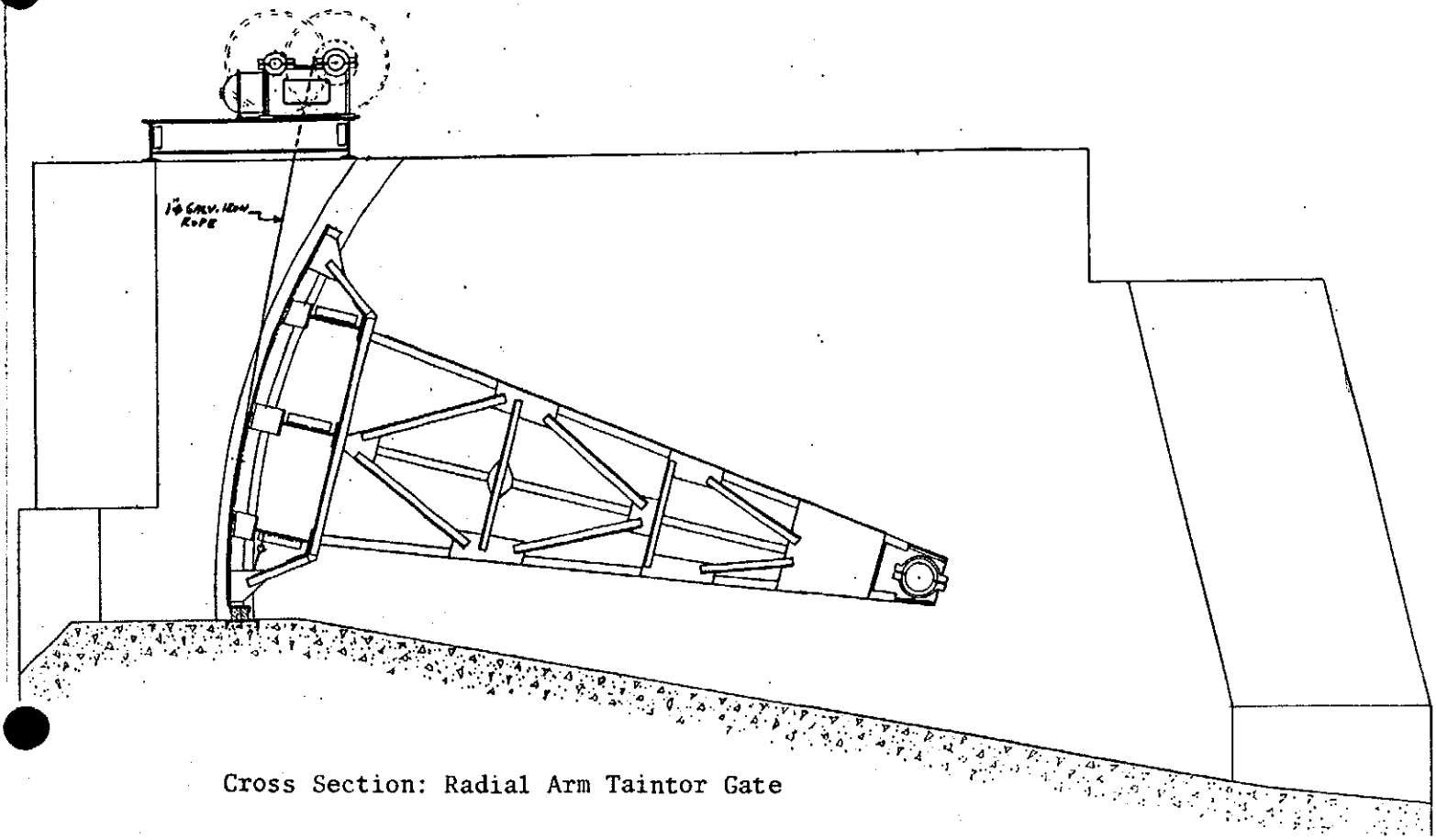
Development of the Shoshone complex involved four major construction projects: the main hydro plant itself, a water diversion tunnel, a diversion dam, and a power transmission line. In addition, a small 1000 horsepower generating plant was built on the north side of the river just below Shoshone Falls to provide limited electrical power during construction of the main plant. This first plant was removed after the Shoshone complex was completed.[4]

The Shoshone Hydro Plant complex was designed to take advantage of the drop in elevation through the central part of Glenwood Canyon. Water was to be diverted from the river just above Shoshone Falls and delivered to the plant through a long tunnel drilled in the north canyon wall. Original company plans called for construction of a 12.9-mile tunnel and pipeline extending from just east of the falls to a storage reservoir 4.8 miles west of Glenwood Springs (see Appendix A, Figure 1). Economic problems forced Colorado Power to reduce the scale of their project considerably and settle on a "temporary" location for the plant within the canyon.[5]

Construction on the diversion tunnel began in January, 1907, and required two full years to complete. To facilitate this labor, eight adits were driven into the canyon wall to allow work to proceed from both ends and at eight intermediate points along the way. (A ninth adit was driven in 1915.) When completed, the tunnel was approximately 12,450 feet long and averaged 13 feet in height by 16'8" in width. The floor and sides were lined with concrete to reduce friction and turbulence, and in places where the rock was weak or fractured a concrete arch was built as well (see Appendix A, Figure 2). The tunnel was constructed with a very low hydraulic grade and had an original capacity of 1250 cubic feet per second. In 1929 the capacity was increased to 1408 cubic feet per second by forcing air into the tunnel through Adit #2. Air pressure reduced wave motion in the tunnel, further reducing friction and turbulence.[6]

Construction of the 245-foot wide Shoshone Intake Diversion Dam began during 1907 and was completed in the spring of 1910. The original dam was a complex "bear trap" structure designed to release excess water near the river bed level through a series of large V-shaped wooden gates. These gates, or "bear traps", formed the central part of the dam and were supposed to lift up through the combined effect of water pressure and an overhead hoist system (see Appendix A, Figure 3, and the detail of Section A-B).[7] When the traps were elevated, the dam was closed; when lowered, water was allowed to pass through.

Apparently this bear trap system was never effective, and required modification almost immediately. The first modifications occurred as early as 1911 and have continued to the very recent past. The bear traps were finally removed beginning in 1930 and replaced with far more efficient radial arm taintor gates (see illustration below). The present dam has four taintor gates and two heavy wooden flash board gates made up of removable sections. The flash boards are removed by use of an overhead hoist and appear to be original features of the dam.[8]



Cross Section: Radial Arm Taintor Gate

In spite of these river control modifications, the dam continues to serve its original purpose of deflecting water from the Colorado River into the diversion tunnel. Most hydroelectric plants in this country rely on a stored capacity of water such as a reservoir or natural lake as a source of power rather than on the normal flow of a river. At Shoshone, the river backs up behind the dam, creating a holding pond which eliminates daily fluctuations in water capacity used for hydroelectric power generation. This does not eliminate seasonal variations in power.[9]

Construction of the power plant itself appears from early photographs to have been completed in early 1909. The original plant was a simple 138x32 foot steel framed structure which housed two 9,000 horsepower Francis turbines and two 5,000 kilowatt alternating current generators. Water was directed from the end of the diversion tunnel to the turbines through two 9-foot diameter steel pressure pipes, or penstocks. The original penstocks are still in place and measure 287 feet in length. The static head or drop in elevation from the tunnel to the generators is 165 feet (see Appendix A, Figures 4 and 5).[10]

Operations at the new plant began in late spring 1909, though some uncertainty exists over the exact date.[11] In 1910, the first full year of production, the Shoshone plant generated 38,096,600 kilowatt hours of electricity, far below its projected power rating of 90,000,000 kilowatt hours. Several modifications have increased the plant's output to about 104,000,000 kilowatt hours per year.[12]

To carry its generated electricity across the state, Colorado Central Power erected a 153-mile transmission line from the Shoshone plant to Denver by way of Leadville, Georgetown and Idaho Springs. A second line ran to Glenwood Springs. About 37 miles of the Denver line were completed east of Leadville in 1907, and the entire line to Denver was finished by late 1908 or early 1909. After rising more than 1500 feet from the canyon floor, the line crossed some of Colorado's most rugged terrain, including Hagerman Pass (12,055 feet), Fremont Pass (11,346 feet) and Argentine Pass (13,532 feet). When it was completed, the Shoshone line was the highest transmission line in the world. Today the alignment remains essentially the same as the original, but the transmission towers have been replaced, and the entire network has been significantly altered.[13]

During the nearly 2½ years of peak construction activities, Central Colorado Power employed between 1000 and 1500 men. Most of these employees were housed at a large camp in the canyon built just east of the dam site. The camp was called Shoshone. Shoshone was originally a railroad siding and small construction camp on the south side of the river built by the Denver and Rio Grande Railroad during the late 1880s. Central Colorado Power erected buildings on both sides of the river with the vast majority of structures on the north bank (see Appendix A, Figure 6). The power company provided housing, meals, medical care, a post office, apartment units for married workers, and even a school for employees' children. A large receiving warehouse was built on the south side of the river near the railroad depot, and the Colorado Provision Company, a subsidiary of Central Colorado Power, built a large company store on the north shore among the bunk houses. A two-span through truss bridge crossed the river at the east end of the camp to provide easy access back and forth. Like many other construction boom camps, Shoshone quickly faded when the work was done. Today, nearly all traces of the camp have disappeared.[14]

While construction activities were under way in the canyon, and for several years after the plant began operations, the only road through Glenwood Canyon was the primitive Taylor State Road constructed on the north side of the river between 1899 and 1902. It was narrow and rough and was closed to all traffic through most of the winter and during periods of high water in the spring. The condition of this road forced Central Colorado Power to bring in most of their equipment, food and supplies by railroad and transport it across to the north shore on an overhead cable. One cableway with a 558-foot span was erected beside the power plant, and a second cableway with a 351-foot span was erected above the dam.[15]

When construction activities ended, Central Colorado Power built housing at the hydro plant and dam site for workers who operated the complex year-round. From the beginning, a large bunk house and an apartment house were in use at the plant, and a small house and garage were built for the chief operator at the dam. Sometime around 1920 two small houses were built along the river just east of the plant for the Shoshone Hydroelectric Plant superintendent and his chief operator.[16]

Changes at the hydro plant have occurred continuously through the years but have not substantially altered the general appearance, setting or historical importance of the plant. Almost immediately after operations began in 1909, a machine shop was constructed onto the east end of the plant. A lean-to shaped washroom (now a washroom and lunchroom) was added onto the east side of the machine shop in 1935, and several support buildings were built and moved around the outside of the plant in the early years. Sometime before 1920 the roofline of the main plant was modified to provide a row of ventilation louvers, and two small horse barns fell victim to the automobile age and were torn down. In the late 1930s, when the Glenwood Canyon highway was substantially widened and paved, the boarding house was torn down, the two houses at the plant and the single house at the dam were moved away from the complex, and a new office building/garage was built on the west side of the plant. In 1963 the old apartment house was torn down to make room for a new 115,000 volt substation which stands on a small terrace west of the office building.[17]

Central Colorado Power's financial problems not only resulted in construction of a "temporary" plant at Shoshone but ultimately led to foreclosure in 1913. At the same time that construction was underway in Glenwood Canyon, the company was at work on even larger hydroelectric projects in Boulder Canyon and Gore Canyon (both in Colorado) and had a number of survey crews in the field on other projects. Overexpansion and rapid expenditure of capital forced a financial reorganization. On April 2, 1913, the Colorado Power Company was created and absorbed the assets and properties of Central Colorado Power, including the Shoshone hydroelectric complex.[18]

The Colorado Power Company retained owernship of the Shoshone Hydro Plant for eleven years and directed many of the changes described above. In September, 1924, Colorado Power merged with the newly formed Public Service Company of Colorado.[19] Public Service retains ownership today.

In spite of the modifications made to the complex, the hydro plant, dam and diversion tunnel retain much of their original integrity. A description of the structures at the plant and dam site follows. Boundaries for the

historic complex and building locations are shown on the three maps in Appendix B.

Shoshone Complex: Brief Description of Buildings and Structures

(Refer to Maps 1, 2 and 3 in Appendix B for structure location and identification.)

MAP #1:

Shoshone Intake Diversion Tunnel (1907-1909). The diversion tunnel extends from just east of the Shoshone Diversion Dam to a point immediately above the power plant, a total distance of 12,453 feet. A profile study of the tunnel conducted in 1924 recorded a very irregular ceiling height varying from 11'4" to over 17 feet, with an average height of about 13 feet. The width is 16'8" and the floor and lower walls are lined with concrete. Approximately 15% of the tunnel ceiling is also completed in concrete. The tunnel functions on gravity flow and was constructed with a .06% grade from the diversion dam to the forebay. Of the nine adits drilled into the tunnel, three have been abandoned. Adit #6 serves as the main access to the tunnel for maintenance repairs and clean up and Adit #2 houses the two air compressor units which force air into the tunnel, thereby increasing the water carrying capacity of the tunnel and the electrical generating capacity of the hydro plant.

MAP #2:

A. Shoshone Hydroelectric Plant (1908-09). The main building of the complex is a steel framed structure with sheet metal siding supported by a concrete foundation and floor. The entire structure measures approximately 225 by 36 feet and stands about 27 feet high at the top of the roof. The western two-thirds of the building houses the turbines and generators, the electrical control room and switchboard, circuit breakers, carrier cabinets, relay equipment, and some storage areas. Over the years the windows on the south facade of this part of the hydro plant have been increased in size and now

extend from just above ground level to just below the roofline. The eastern third of the building consists of two additions easily defined by the varied roofline. The first was added on to the main plant before the end of 1909 and houses a machine shop. The second was built in 1935 as a washroom, electrical shop and warehouse. The electrical shop has since been converted into a lunch room. Behind the plant to the north is a small open courtyard in which the 69,000 volt substation and the 13,000 volt distribution line are located. A poured concrete retaining wall stands 15 to 19 feet high along the canyon wall and was built in 1946.

B. Garage (below) and Office Building (1937). This is a simple wood sided two story building with a five bay garage below and office space above. The second story is divided into a large assembly room on the west, an office and files area in the southeast corner and a restroom and kitchen area located in the northeast corner. The building was constructed in 1937 and replaced an earlier single story garage which was torn down during the U.S. Highway 6 construction in 1937.

C. 115 Kv Substation (1963). The 115,000 volt transmission line substation was built on the site of the original hydro plant apartment house (1909). This large two story building was torn down in 1963 and a concrete pad was poured on the terrace above and west of the office building. The old 115 kv substation was removed from the west end of the hydro plant and rebuilt on the pad. It is surrounded by an eight foot chain link fence.

D. Storage Building/Garage (1978). This double bay garage was constructed in 1978 of poured concrete with a reinforced concrete roof. An earlier wood garage built on this same location collapsed after rocks tumbled down the canyon wall onto the roof. The rock wall to the east of the garage was rebuilt in 1978.

E. Twin Penstocks (1908-09). The penstocks are original and measure 287 feet in length and 9 feet in diameter. They transfer water from the forebay to the turbines with a 165 foot drop in elevation. The upper one-third of the penstocks are now buried to protect against falling rocks.

F. Forebay (1908-09). The forebay measures approximately 18 feet wide by 12 feet deep and is built back into the north canyon wall where it joins the end of the water diversion tunnel. The east, west and north walls are of granite with wood and concrete walls extending out beyond the canyon wall. The south wall of the building is wood siding above a concrete foundation. An 8 foot high concrete wall rises above the forebay to deflect falling rocks and prevent them from rolling onto the penstocks. Inside the forebay are two water control gates to the penstocks and the electrical motor which controls them. The original wooden gates were replaced with steel gates in 1925.

G. Hoist House (c. 1907). The hoist house is a small wood frame building with sheet metal siding set on a concrete foundation and floor. Inside is the electrical motor which controls the 558 foot cable which stretches from the hoist house to the south cableway tower across the Colorado River. Both the north and south A-frame cableway towers were rebuilt in 1940.

H. Compressor Building (c. 1914). This building houses an air compressor used for maintenance purposes and as a backup source of air pressure for the governor controls on the turbine generators. The building appears to be a small six foot square wood sided building but it actually extends about four feet back into the granite canyon wall. The exterior portion of the structure stands on a raised concrete pad.

I. Blacksmith Shop (c. 1914). This is a small 16 by 8 foot wood frame building with sheet metal siding and a gently sloping lean-to roof. Three large windows on the west side provide lighting. Blacksmithing activities ceased long ago and the building is now used for storage. A rectangular storage rack for metal pipe is located beside the blacksmith shop.

J. Oil House/Flammable Storage Building (1939). This is a small 6 by 8 foot rectangular storage shed with sheet metal siding. Gasoline, turbine oil and other flammable liquids are stored here.

K. Spillway (1915). The spillway is an open steel trough with a ten foot diameter which allows excess water in the tunnel to overflow before reaching

the forebay. The large concrete and wood box at the base of the spillway is a loading and unloading dock used with the overhead cable system. A long metal stairway beside the spillway provides access to the hoist house, forebay and potable water storage tank located above the plant. The original spillway (1908-09) was an 8 foot diameter wooden flume built just ten feet to the east of the present spillway.

MAP #3:

L. Shoshone Intake Diversion Dam (1907-10). The Shoshone Dam measures approximately 245 feet in length where it crosses the Colorado River near the Denver and Rio Grande Railroad's Tunnel Number 2. The dam is concrete and stands 20 feet above the stream bed. It is supported by pilings driven 30 feet and more into the sand and gravel and has a broad concrete apron extending downstream. There are six river control gates in the dam, four radial arm taintor gates and two wooden flash board gates. The flash boards are comprised of individual sections which are lifted out of the face of the dam by using a large hook connected to the overhead cableway. It appears that this system is original to the dam. Repair work has been ongoing at the dam since at least 1911. Major reconstruction of the piers occurred in 1930, 1942, 1946, and 1952-53 and the concrete apron below the dam was rebuilt in 1952-53. Replacement of the original and ineffective bear trap flood control gates occurred in 1930, 1937 and 1951. An original through truss footbridge built on top of the dam was removed beginning in 1930 and the present walkway was completed in 1940.

M. Gate House to the Diversion Tunnel (c. 1924). The gate house is a cinder block structure with a sheet metal roof built back into the granite north wall of the canyon. Within the building are the four control gates which regulate the flow of water entering the diversion tunnel and the hydraulic controls which operate them. All electrical controls for the dam complex are located in the building and there is a motor generator set which provides emergency backup electric power for the dam. This set consists of a 6 cylinder Ford industrial engine fired by propane and a 220 volt generator. The present gate house may have been built around 1924 when the first mechanical trash rakes were installed in front of the tunnel gates or in 1926 when the original

wooden tunnel gates were replaced with steel gates. Trash rakes clear debris away from the large metal screens, or grizzlies, placed across the entrance to the gate house and tunnel. Large floating objects like trees and branches are deflected away from the grizzlies by a floating trash boom which angles across the front of the gate house to the corner of the dam. The present trash boom was floated into place in the spring of 1944. Inside the gate house there is a small glass enclosed office used by the gate tender on duty.

N. Transformer and Switch Rack (Rebuilt, date unknown). 13,000 volts of electricity are distributed from the Shoshone Hydro Plant to the transformer at the dam complex. The switch rack steps this voltage down to 440 volts used by the Denver and Rio Grande Railroad across the river and to 220 volts for use at the dam site and the rest area east of the dam.

O. Hoist House and Cableway (1907). This small sheet metal building houses the electrical hoist motor and the controls for the overhead cableway. The cable system stretches approximately 300 feet between the anchor point on the north canyon wall and a cableway tower south of the river. The cableway system may well have been rebuilt in 1940 when the cable system at the power plant was replaced. Engineering records do not indicate if or when the cable system at the dam was replaced. The cableway is used for removing the flash-boards from the dam and for clearing out trees and branches from behind the dam.

P. Steam Cleaner Building (c. 1930). This small wood framed building has corregated slate siding and an asphalt shingled roof. It houses an electrical/propane-fired steam cleaner used for melting ice off the Number 1 taintor gate located at the north end of the dam. During periods of cold weather when ice freezes on the dam the steam cleaner is used to thaw out the first gate so that excess water can be released from behind the dam.

Q. Restroom Building (c. 1930). The restroom building is a small square wood framed building with corregated slate siding and an asphalt shingled roof. A self contained chlorine treatment leaching field is used for sanitation.

Footnotes

1. "Another New Power Plant," The Denver Times, June 19, 1903, p.2. The name of the Grand River was changed in 1907 to the Colorado River by the Colorado Legislature. This change was not officially recognized by the U.S. Government until July, 1921. The name of the canyon was changed to Glenwood Canyon by a resolution of the Board of Garfield County Commissioners in 1914 and was accepted by the U.S. Government two years later. (Erlene Durrant Murray, Lest We Forget: A Short History of Early Grand Valley, Colorado, Originally Called Parachute, Colorado. Grand Junction, Colo.: Quahada, Inc., 1973, p. 1; Lena M. Urquhart, Glenwood Springs: Spa in the Mountains. Boulder, Colo.: Pruett Publishing Company, 1970, p.124.)

2. Lena M. Urquhart, op. cit., p. 48; E. C. LaRue, Colorado River and Its Utilization, U.S. Department of Interior, U.S. Geological Survey, Water-Supply Paper 395. Washington: Government Printing Office, 1916, pp. 169-174; Ralf R. Woolley, Water Powers of the Great Salt Lake Basin, U.S. Department of Interior, U.S. Geological Survey, Water-Supply Paper 517. Washington: Government Printing Office, 1924, pp. 64-108. The power rating of the Shoshone plant was projected to be 18,000 horsepower, larger than any other hydro plant in the Colorado River Basin at that time.

3. Public Service Company of Colorado, "Facts About Shoshone", informational brochure, 1975.

4. Central Colorado Power Company, "Report of Progress - October 1st, 1908." Denver: the Carson-Harper Co., 1908. Water was diverted from the Grand River to the plant through a long six-foot diameter pipe erected on the north bank of the river.

5. Public Service Company of Colorado, Electrical Engineering Files and Records Room, 5525 East 38th Avenue, Denver, Colorado: Shoshone Hydro Plant files, maps and photographs; Central Colorado Power Company, op. cit., pp.13-15. The Shoshone Plant is shown on Figure 1, Appendix A, as Glenwood No. 1 Power House near the top right corner of the map. The proposed Power House No. 2 is located in the bottom left corner of the map.

As late as 1908, Central Colorado Power was committed to extending the tunnel "a considerable distance down the river" beyond Shoshone, but just how far is unknown. In December, 1908, there were published reports in the Glenwood Springs Daily Avalanche that the company planned to keep 750 men at work through the winter of 1909-10 extending the tunnel 1.2 miles west to Grizzly Creek. Although this work was never done, the idea of building a new power plant at Grizzly Creek resurfaced in the late 1920s when serious consideration was given to replacing the Shoshone plant. Construction plans called for extending the tunnel 7,500 feet west and construction a reservoir upstream on Grizzly Creek. A new plant with more than twice the generating capacity of Shoshone would have been built along the Colorado River. ("Grizzly Creek Hydro Power Project," Public Service Company of Colorado, unpublished company report in the Shoshone Hydroplant Files, November, 1929.)

The existing plant was apparently built as a temporary solution to financial problems facing the company which may explain its steel frame and sheet metal siding construction. The company definitely planned to discontinue operations at Shoshone after a new hydro plant was completed farther down the river and either sell off the old equipment or use it elsewhere.

6. Central Colorado Power Company, op. cit., pp. 9, 13; Public Service Company, "Facts About Shoshone," op. cit.; Public Service Company, Electrical Engineering Files, op. cit.; Interview, Bill Neil, Shoshone Hydro Plant, Maintenance Foreman, July 30, 1982. The actual drop in elevation from the tunnel floor at the dam to the tunnel floor above the power plant is only eight feet. Compressors located in Adit Number 2 force the air into the tunnel.

7. William P. Creager and Joel D. Justin, Hydroelectric Handbook. New York: John Wiley and Sons, Inc., 1927, 1950, p.512. Public Service Company, Eletrical Engineering Files, op. cit.; Interviews, Chuck McClain, Shoshone Hydro Plant, Supervisor of Production, November 14, 1979 and July 28-30, 1982. The crib dam which shows on the original engineering drawings (Appendix A, Figure 2) was built to prevent water from seeping along the sand and gravel river bed to the permanent dam. While this helped, it was necessary to dig a deep trench under the permanent dam to drain water away while the concrete was drying. To keep the concrete from freezing during winter construction, a huge tent was erected over the dam. These were only a few of the many complex engineering problems encountered and solved during construction. (E. L. West, unpublished memoirs in the collection of the Boulder Hydroelectric Plant, Boulder Canyon, Colorado.)

8. Interviews, Chuck McClain, op. cit., July 28-30, 1982; Interview, Jack Carrington, former Shoshone Hydro Plant Operator, Glenwood Springs, Colorado, July 30, 1982. Mr. Carrington reported that sections of the old bear trap dam were still in place in 1943 when he went to work at Shoshone.

9. Public Service Company, "Facts About Shoshone," op. cit.; Interview, Chuck McClain, op. cit., November 14, 1979. Although the dam does back the river into a considerable holding pool, it does not create an actual reservoir. During periods of low water each winter the entire flow of the river is diverted through the tunnel to drive a single turbine at the plant. In spring and summer there is enough volume to drive both turbines at the plant and still allow excess water to spill over the dam. (Public Service Company of Colorado, "Serving Colorado Over Sixty Years: Shoshone Hydroelectric Plant," informational brochure, n.d.)

10. Central Colorado Power Company, op. cit., p. 13; Public Service Company, Engineering Files, op. cit. Photographs of the plant and dam can be found at the Public Service Company in Denver and at Shoshone, the Western History Collection of the Denver Public Library, and the Stephen H. Hart Library of the Colorado Historical Society.

11. LeRoy R. Hafen, ed., Colorado and its People: A Narrative and Topical History of the Centennial State, 4 vols. New York: Lewis Historical Publishing Co., Inc., 1948, Vol. I, p. 580; Public Service Company, "Facts About Shoshone," op. cit. Public Service Company records indicate the plant may have gone on line on June 6, 1909. Hafen sets May 24, 1909 as the date Shoshone began generating power. It is possible that the earlier date was a system test prior to actually producing power for transmission and commercial use.

12. Interviews, Chuck McClain, op. cit., November 14 and December 12, 1979.

13. "Public Service Company of Colorado Centennial," Lines, Vol. 34, No. 10 (November, 1969), p. 43; Central Colorado Power Company, op. cit., pp.21-23. In 1981 the eligibility of the Shoshone transmission line for inclusion on the National Register was investigated. It was determined that while the route of the line was historic, all towers, lines, and other physical remains had been changed several times through the years. Today's transmission line represents modern technology and is therefore not eligible to the National Register. (Interview, Dr. Floyd Patterson, Director, Cultural Resources Consultants, Denver, Colorado, September 15, 1982. Dr. Patterson did the research for the determination of eligibility.)

14. Colorado Department of Highways, Map Files, Denver, Colorado, Denver and Rio Grande Railroad Valuation Maps, Map V-8-A, Sheet 13, June 30, 1919; William H. Bauer, James L. Ozmont and John H. Willard, Colorado Postal History: The Post Offices. Crete, Nebraska: J-B Publishing Company, 1971, p. 119. As late as 1919 the railroad camp at Shoshone had telegraph and freight offices, bunk houses, a tool house, depot,and a 16x24-foot water tower. The post office was only open during the years of peak construction in the canyon, from September 3, 1907 through June 30, 1910. Today there are some stone foundations on the north side of the river above the present roadway and some concrete foundations and low stone walls south of the river. The old truss bridge was removed in the 1960s.

15. Lena M. Urquhart, op. cit., pp. 122-124; Bob Campbell, "Road Building Was Lot Simpler 50 Years Ago," in Colorado West, the Sunday Magazine of the (Grand Junction, Colorado) Daily Sentinel, March 18, 1973, pp.10-13; Public Service Company, Engineering Files, op. cit. The condition of the Taylor State Road forced Central Colorado Power to provide housing for its employees within the canyon, first at Shoshone, and later on at the plant complex. The first major improvement of the Taylor State Road was undertaken by the newly created State Highway Department. The job was completed in May, 1920. The second major reconstruction occurred between 1936 and 1938 when the roadway was substantially widened and received its first asphalt surface.

16. Interview, Chuck McClain, op. cit., November 14, 1979; Public Service Company, Engineering Files, op. cit.

17. Public Service Company, Engineering Files, op. cit. The most dramatic planned alteration of the Shoshone plant (aside from the original plan to abandon it) occurred in the early 1940s when detailed drawings were prepared for construction of a brick and tile facade for the entire main building. Like so many other plans for Shoshone, this work was never begun.

18. LeRoy R. Hafen, op. cit. Vol. I, pp. 580-81; Central Colorado Power Company, op. cit., pp.15, 19; Public Service Company, "Facts About Shoshone," op. cit.

19. LeRoy R. Hafen, op. cit., Vol. I, p. 581.

APPENDIX A:

Shoshone Hydroelectric Plant Complex:

Engineering Plans

Figure 1: Glenwood Power Canal and Pipeline (June, 1908)

Figure 2: Tunnel Details (August, 1909)

Figure 3: Headworks, Shoshone Intake Diversion Dam (August, 1909)

Figure 4: General Layout, Forebay and Penstocks (November, 1908)

Figure 5: Power House Arrangement (November, 1908)

Figure 6: Key Map of Glenwood No. 1 Development (April, 1907)

Note: These 6 plans are included separately in the photograph documentation for HAER No. CO-5 and are numbered CO-5-20 through CO-5-25 consecutively.

APPENDIX B:

Maps of the Shoshone Hydroelectric Plant Complex:

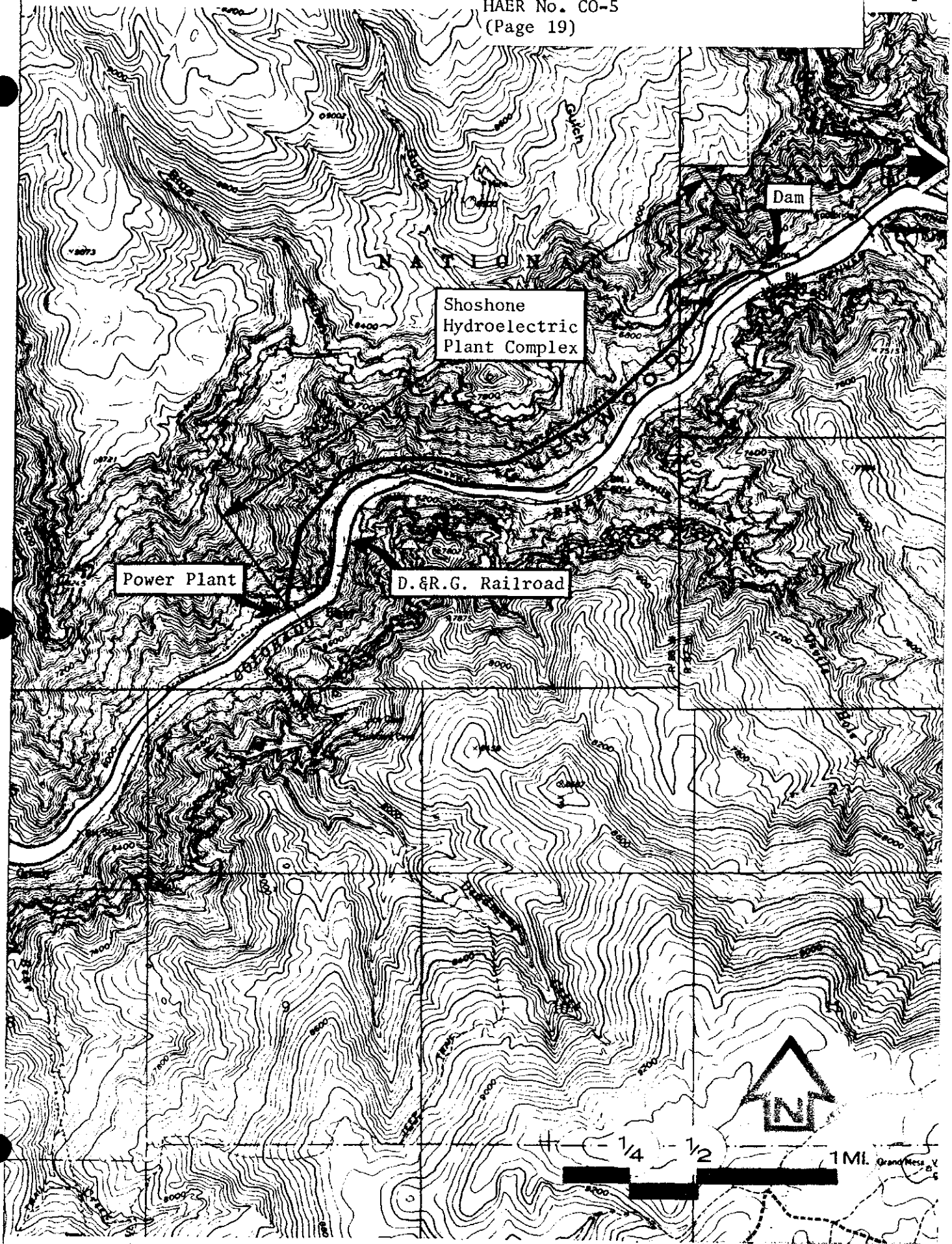
Building/Structure Locations and Site Boundaries

Map #1: Shoshone Hydro Plant Complex: Overview

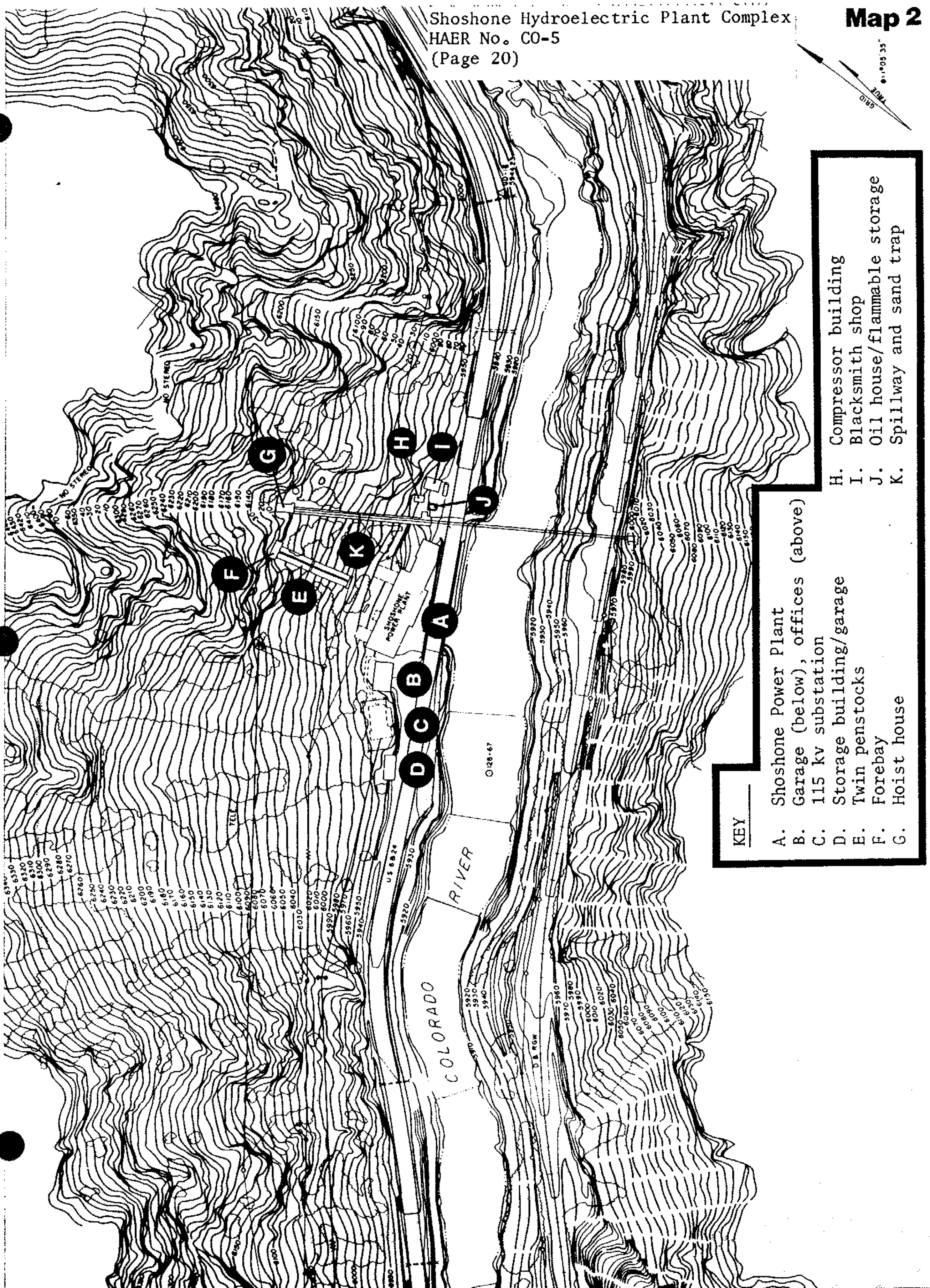
Map #2: Shoshone Hydro Plant and Surrounding Structures

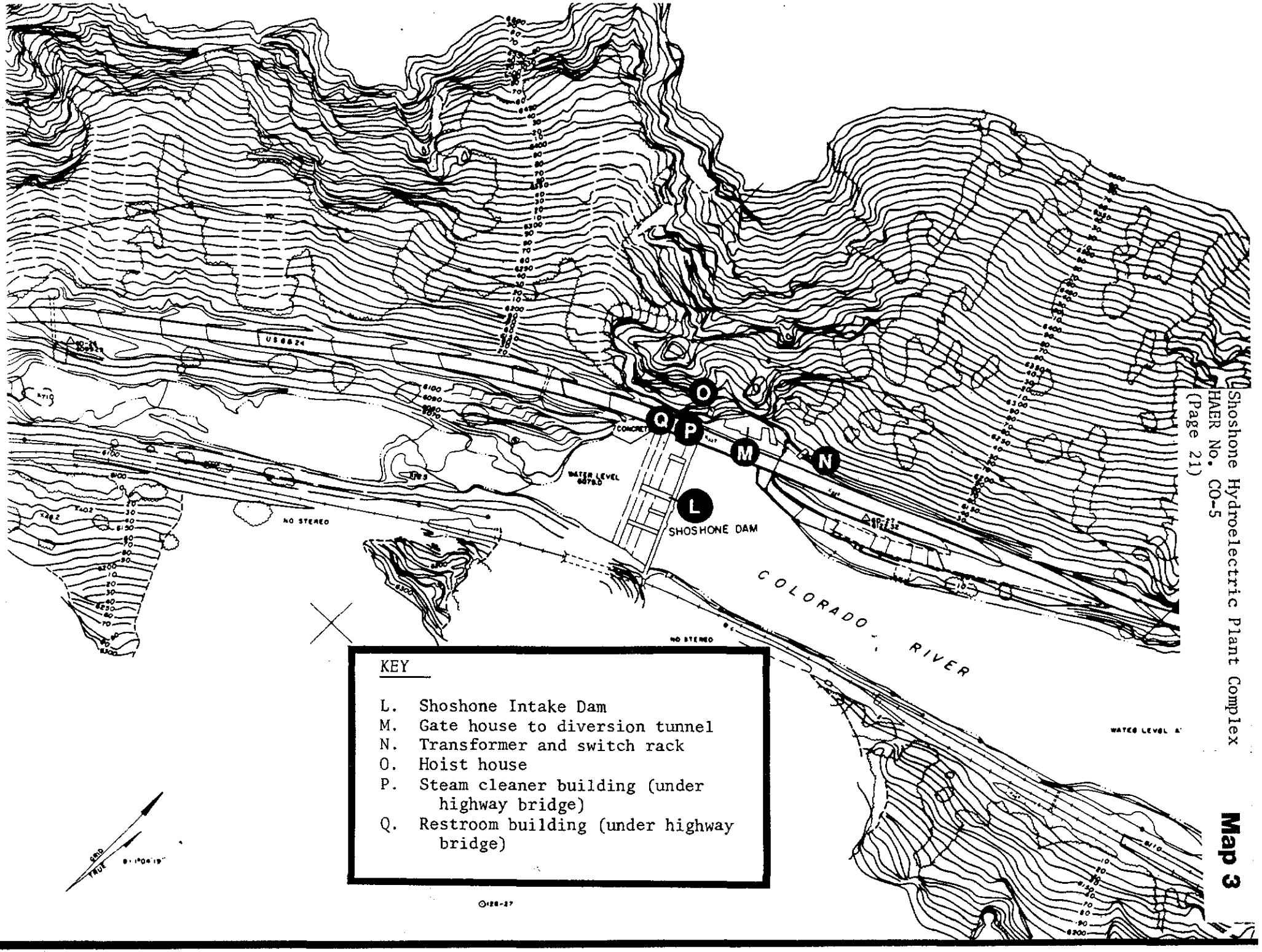
Map #3: Shoshone Intake Dam and Surrounding Structures

Shoshone Hydroelectric Plant Complex **Map 1**
HAER No. CO-5
(Page 19)



Map 2


KEY
A. Shoshone Power Plant
B. Garage (below), offices (above)
C. 115 kv substation
D. Storage building/garage
E. Twin penstocks
F. Forebay
G. Hoist house
H. Compressor building
I. Blacksmith shop
J. Oil house/flammable storage
K. Spillway and sand trap
SHOSHONE POWER PLANT
COLORADO RIVER
US 6 & 24
D & RGW
NO STEREO
TRUE
GRID

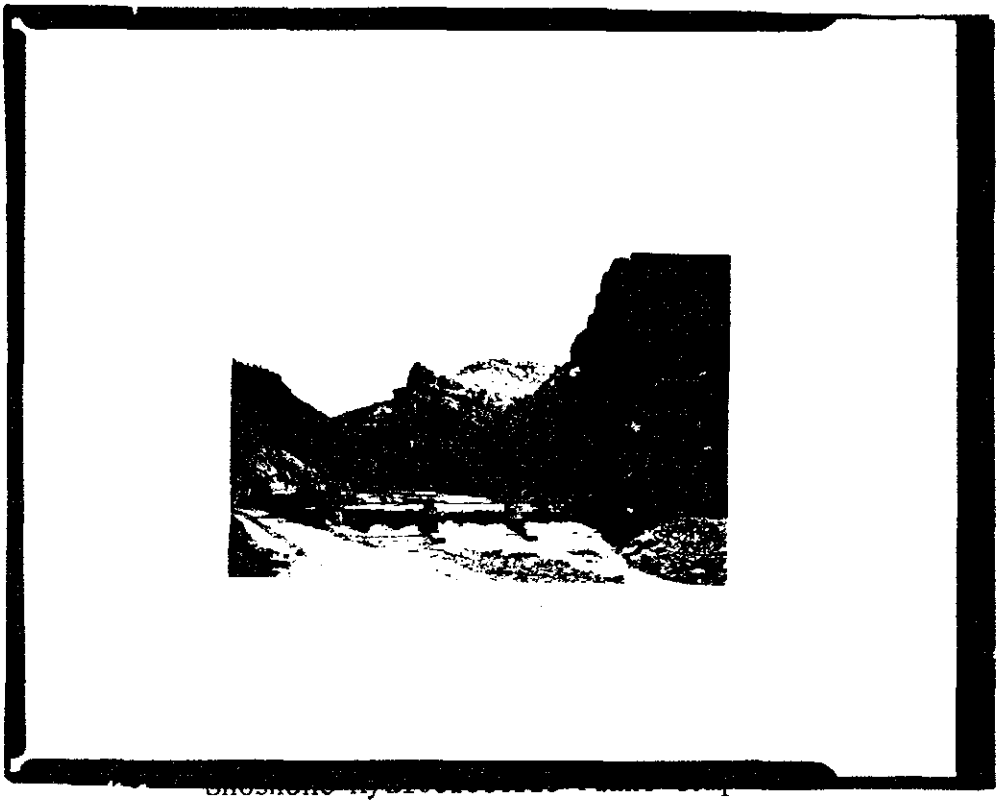


KEY

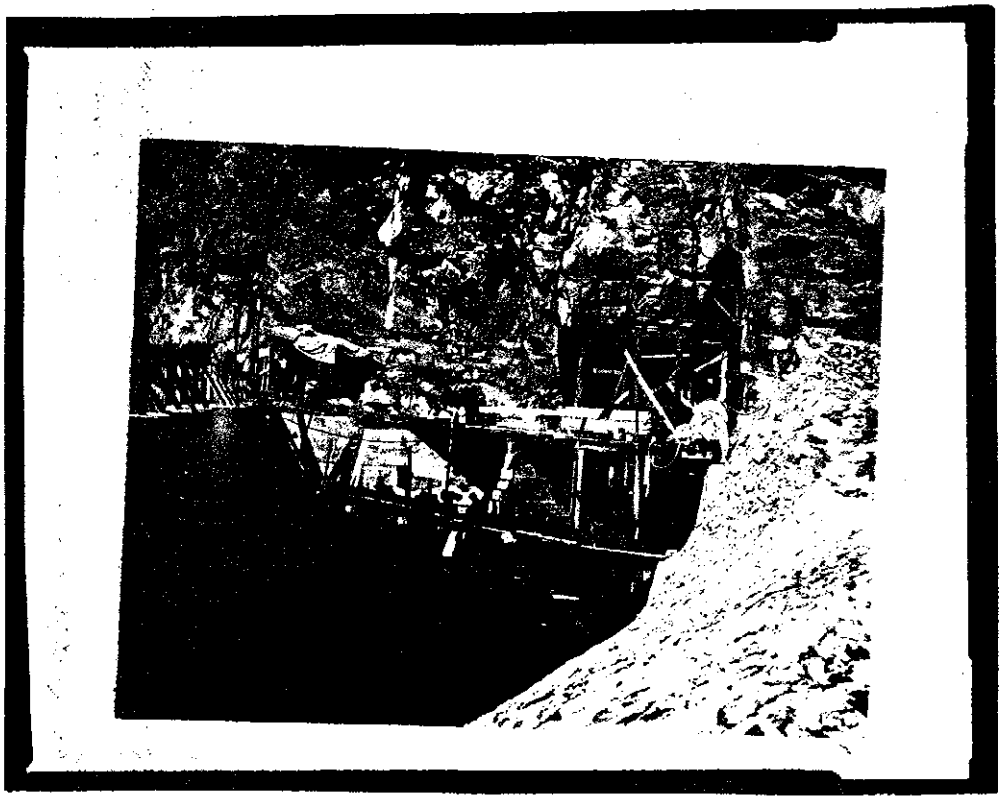
L. Shoshone Intake Dam
M. Gate house to diversion tunnel
N. Transformer and switch rack
O. Hoist house
P. Steam cleaner building (under highway bridge)
Q. Restroom building (under highway bridge)

Shoshone Hydroelectric Plant Complex
HAER No. CO-5
(Page 21)

Map 3

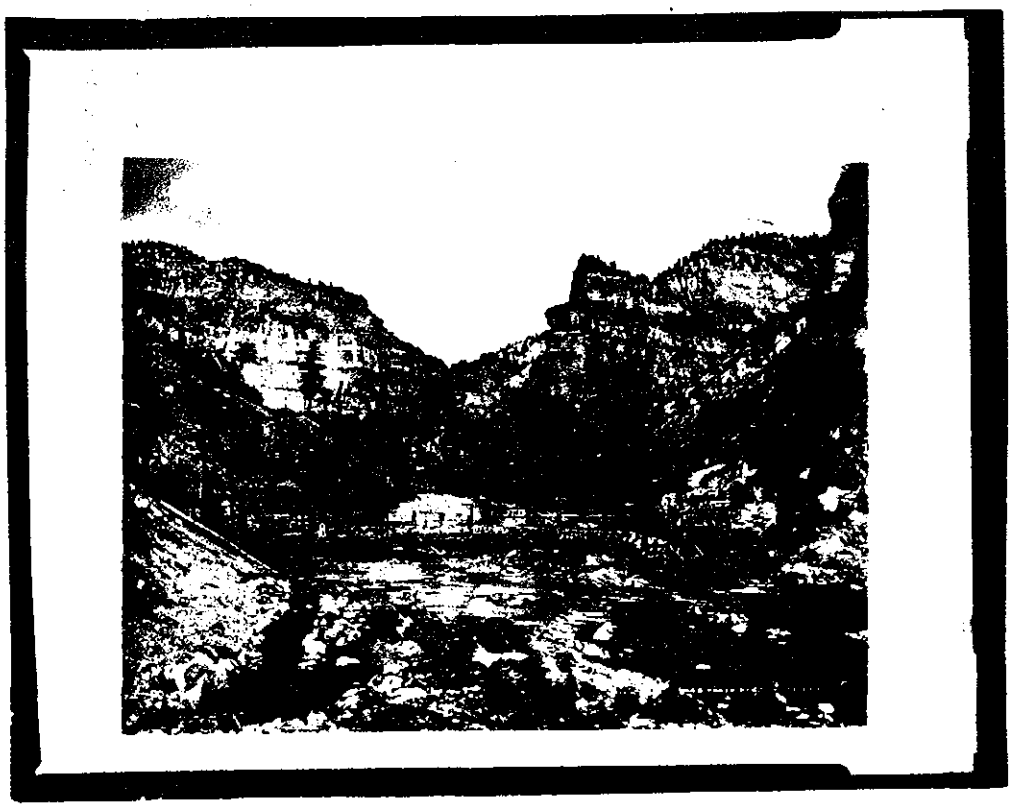


Photocopy of photograph (original print in the Carleton L. Hubbard, Jr., Collection, Glenwood Springs, Colorado)
John Schutte, Photographer, Circa 1914
SHOSHONE INTAKE DIVERSION DAM AND THE TAYLOR STATE ROAD (LATER U.S. HIGHWAY 6)



Shoshone Hydroelectric Plant Complex

Photocopy of photograph (original print in the Public Service Company of Colorado, Denver, Colorado)
L. C. McClure, Photographer, Circa 1908
CONSTRUCTION OF THE INTAKE TO THE DIVERSION TUNNEL

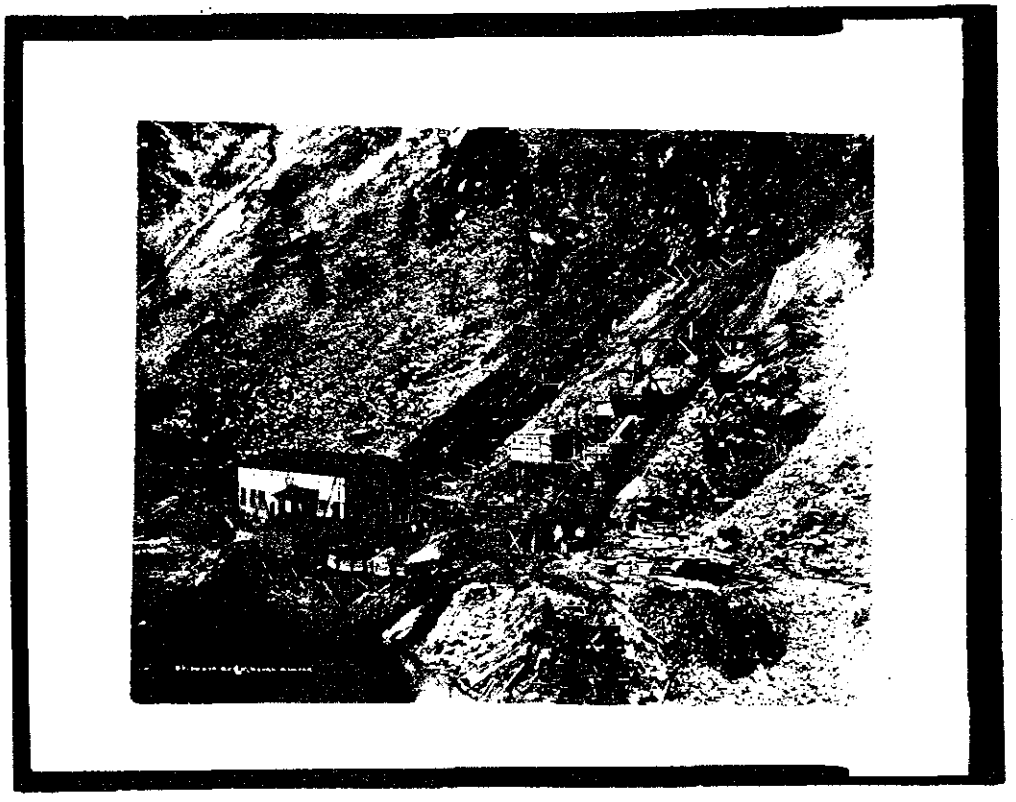


Shoshone Hydroelectric Plant Complex

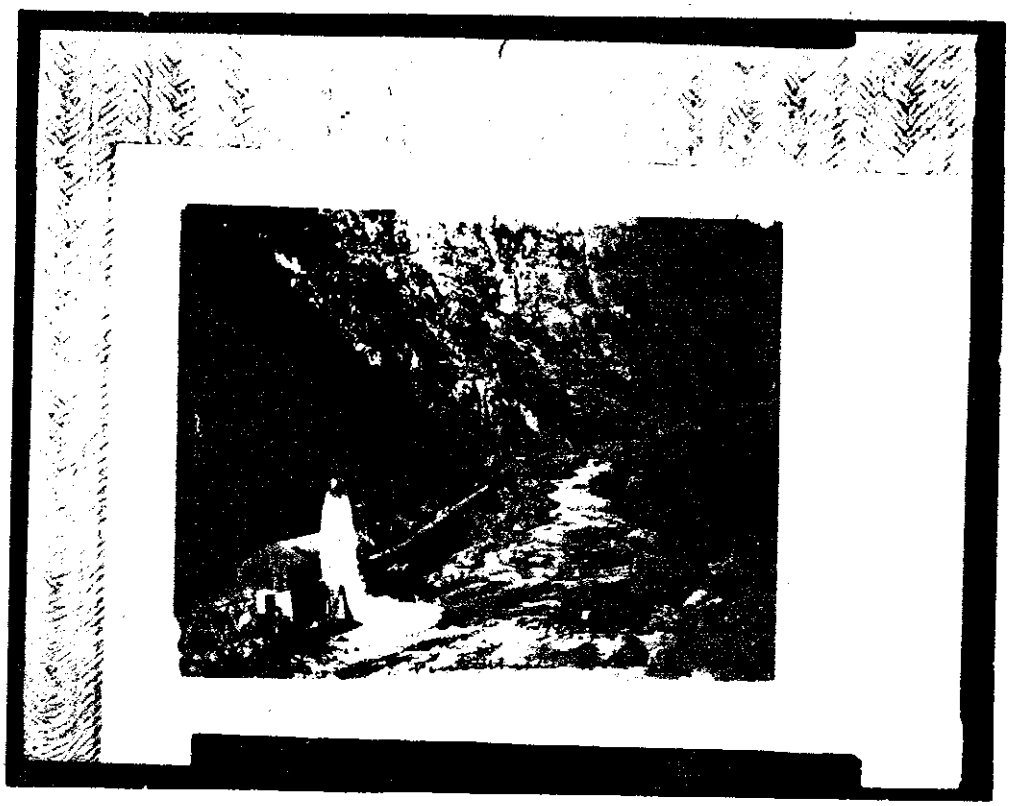
Photocopy of photograph (original print in the Public Service Company of Colorado, Denver, Colorado)
L. C. McClure, Photographer, Circa 1908
CONSTRUCTION OF THE INTAKE TO THE DIVERSION TUNNEL

Shoshone Hydroelectric Plant Complex

Photocopy of photograph (original print in the Public Service Company of Colordo, Denver, Colorado)
L. C. McClure, Photographer, Circa 1908
SOUTH ELEVATION OF THE SHOSHONE HYDROELECTRIC PLANT BEFORE CONSTRUCTION OF THE FOREBAY



Photocopy of photograph (original print in the Public Service Company of Colorado, Denver, Colorado)
L. C. McClure, Photographer, Circa 1908
CONSTRUCTION OF THE SHOSHONE HYDROELECTRIC PLANT



Shoshone Hydroelectric Plant Complex

Photocopy of photograph (original print in the Frontier Historical Society, Glenwood Springs, Colorado)
Photographer unknown, Circa 1907
CENTRAL COLORADO POWER COMPANY'S TEMPORARY POWER PLANT LOCATED BELOW (WEST OF) THE INTAKE DAM, VIEW TO THE NORTHEAST